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Servo Controlled Automatic Voltage Stabilizer with Automatic High & Low Cut-Off Provision

Prof. Rutuja Bhat Warbhe, ME
Dept of Electrical Engineering,
Dr. D.Y Patil Institute of Engineering and Technology.

Shrivatsa Shandilya
BE Student,
Dept of Electrical Engineering,
Dr. D.Y Patil Institute of Engineering and Technology.

Gaurav Kumar Tripathi
BE Student,
Dept of Electrical Engineering,
Dr. D.Y Patil Institute of Engineering and Technology.

Ashish Kumar Rohit
BE Student,
Dept of Electrical Engineering,
Dr. D.Y Patil Institute of Engineering and Technology.

Abstract:
This is a stabilizer which constantly monitors the output voltage and controls the variations in the input voltage by movements of a motor. This motor in turn selects the proper output voltage on the variable transformer (variac). This is probably the cheapest power-conditioning product available. It gives reasonably good voltage regulation and is all right where voltage fluctuations are not considerable. However it is not advisable to use it outside big cities where apart from considerable fluctuations in voltage, the power is full of frequency drifts, failures, noise and spikes. Use of Servo Stabilizer is the only way to control erratic supply voltage conditions. Servo Stabilizer can control all types of loads i.e. inductive, resistive, capacitive loads. Other voltage stabilizers viz. Constant Voltage Transformers or Static Voltage Stabilizers cannot be used in such applications. Servo Stabilizers are available from 1 KVA 1 ph. to 250 KVA 1 ph and 3 KVA 3 ph to 2000 KVA 3 ph. 3 ph. Servo Stabilizers can be for balanced or for unbalanced input voltages.

Keywords:
Voltage stabilizer, LM723, Auto transformer, servo motor etc.

I.INTRODUCTION:

A "servo" is a generic term used for an automatic control system. It comes from the Latin word "servus" - slave. In practical terms, that means a mechanism that you can set and forget, and which adjusts itself during continued operation through feedback.

Servo control is a closed loop control system for electric motors. The motor used in servo control is usually DC motor although AC servo is also possible. The servo system uses a sensor to sense motor position/speed. Servo control has a feedback circuit which changes the drive power going to motor according the control input signals and the signal from sensors. Disk drives, for example, contain a servo system insuring that they spin at a desired constant speed by measuring their current rotation, and speeding up or slowing down as necessary to keep that speed. Many robotics applications contain servo circuits that use motors to position some mechanical parts to desired location. In a servo positioning system the encoder gives the motors position to the servo amplifier and it compares this with the desired position to get the error. The amplifier then sends current to the servomotor to make the motor move into the proper position, reducing the error.

Servo control is usable over variety of compiled motion profiles. Those may involve the following: control of either velocity and/or position; high resolution and accuracy; velocity may be either very slow, or very high; and the application may demand high torques in a small package size. Because of the additional components such as feedback device, complexity is considered by some to be the weakness of the closed loop approach. Those additional components add to the initial cost and complexity of the control system. A typical servo unit consists of a small motor, a gear set, a feedback potentiometer, and some control electronics.

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There are many applications where there is possible to use servo or stepper motor. While the operating concept is similar, in that they're both able to position an object to a given orientation, the mechanism of the two is entirely different, and has distinct limitations on the accuracy available when using each type. To understand which one is better, here are some details of differences between those two: The stepper's resolution is based on the steps (typically 1.8 deg or 3.6 deg per step). In the stepper system, the driver advances one step, and the stepper motor follows. For example a 1.8 deg. stepper will turn a full circle in 200 steps. No matter how you gear it, a stepper motor still moves in discrete steps. Each step covers a specific range of "swing". In a nutshell, a stepper (with or without gear-train) is a set of "preset" positions you can move to. Any position that's not part of the "presets" is unattainable by that motor or motor-and-gear-train combination, and can only be reached as an approximation. Stepping motors can be used in simple open-loop control systems; these are generally adequate for systems that operate at low accelerations with static loads, but closed loop control may be essential for high accelerations, particularly if they involve variable loads. If a stepper in an open-loop control system is over torque, all knowledge of rotor position is lost and the system must be reinitialized, servomotors are not subject to this problem.

II. LITERATUREREVIEW:

1. Optimization of automatic voltage regulator by proportional integral derivative controller

Authors:- Pallav Joshi , Piyush Ghune This paper is basically based on the optimization of working of Automatic voltage regulator by the proportional Intigral derivative controller. In this analysis, optimization is done by very novel concept Particle Swarm Optimization and simulated using MATLAB Simulink software. The primary reason for a programmed voltage controller framework is to keep the voltage extent of a synchronous generator at a predetermined level the generator excitation framework keeps up the generator voltage and controls the reactive power stream.

2. Design and Implementation of an Automatic Voltage Regulator with a Great Precision and Proper Hysteresis.

Authors: Mohammad Shah Alamgir1 and Sumit Dev2

This research aims at the designing and implementation of an Automatic Voltage Regulator (AVR) with higher precision and hysteresis. AC power supplied by PDB (Power development board) in Bangladesh is subjected to variation from time to time. Moreover in rural areas supplied voltage remains lower than specified. This causes a considerable threat to the sophisticated electronic devices like computer, refrigerator, television etc. So ensuring the input voltage to remain in a tolerable pre-specified limit has become a necessity in rural as well as some urban areas. Current systems available locally lacks precision and suffers the problem of oscillating between two output voltage and hence creating surge at the output which can damage valuable electronics. This research handled both shortcomings and introduced in the tolerable range of 215-237 volt using several taps. Hysteresis has been introduced while changing from one level to other and thus preventing oscillation.

3. DESIGN OF A LOW COST SERVO CONTROLLED VOLTAGE STABILIZER

Authors: - G NAVEEN KUMAR

Many types of voltage stabilizers are available in market. In these stabilizers the output is changed manually withswitch to maintain the output voltage constant. During the peak period this manual operation of stabilizer has to be done frequently. This paper presents a low cost servo controlled voltage stabilizer which rectifies this problem.

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4. Digital Servo Controlled Voltage Stabilizer-A Review

Authors:- Pulkit Singh

This article is a study of servo controlled voltage stabilizer in an industrial project. Since the voltage fluctuation comes in the power system, there are many problems developed in the line voltage like distortion, fluctuation, heating, noising, accuracy, power rating, voltage range (230+5%) and power capacity less than 600 VA. Due to these problems, daily use equipments are at risk like fan, laptop, cooler, and refrigerator. To remove these problems, we use voltage stabilizer before the equipment for protection. Mainly two types of stabilizers are present in the market world, one is automatic/line voltage stabilizer and other is (analog and digital) servo voltage controlled stabilizer/regulator. In case of servo stabilizers, different types of power problems are overcome with voltage range (230+1%) and power capacity up to 1000 kVA. So several technical issues related to the digital servo controlled voltage stabilizer and technology have been reduced.

III. SYSTEM ARCHITECTURE:

Triac Gate Control System:

The input 230 V is stepped down to 15V ac and rectified to pure DC using bridge rectifier. This DC power supply is given to all sections of control circuit. Two comparator IC's (Built in single package) are used to detect higher and lower voltage levels. Comparator 1 is provided with a reference voltage of 4.7V and comparator 2 is provided with reference voltage 7.3V.Two PNP transistors are provided for providing control voltage for triacs. Two 100K presets are provided for adjusting the reference voltage. This is to maintain higher cut off voltage of 280V, and to maintain lower cut off voltage of 180V.

LED Indication Circuit:

The input 230 V is stepped down to 15V ac and rectified to pure DC using bridge rectifier. This DC power supply is given to all sections of control circuit. Two comparator IC's (Built in single package) are used to detect higher and lower voltage levels. Comparator1 is provided with a reference voltage of 4.7V and comparator 2 is provided with reference voltage 7.3V.Two PNP transistors are provided for providing indication on LED panel. Two 100K presets are provided for adjusting the reference voltage. This is to indicate display for higher cut off voltage of 280V, and to display for lower cut off voltage of 180V.

Auto Transformer Connection:

The triacs drives the servo motor. Servo motor is provided with three connections. One point is for neutral. Second point is to rotate the servo motor in clockwise direction and the third one is to rotate the servo motor in counter clockwise direction. This servomotor is mechanically coupled with auto transformer. In a servo system the encoder gives the motors position to the servo amplifier and it compares this with the desired position to get the error. The amplifier then sends current to the servo motor to make the motor move into the proper position, reducing the error. The servo's resolution is based on the encoder attached to it, and the servo amplifier's error. A servo is a motor that can be stopped anywhere you want it, with no "detents" either needed or present. You can turn it to any position you like (within its range, of course), and assuming it's been properly "dialed in", it's reasonable to expect that when you say "turn to 4.6 degrees" and punch the "go" button, it's going to turn whatever it controls to point at a reasonable approximation of 4.6 degrees.

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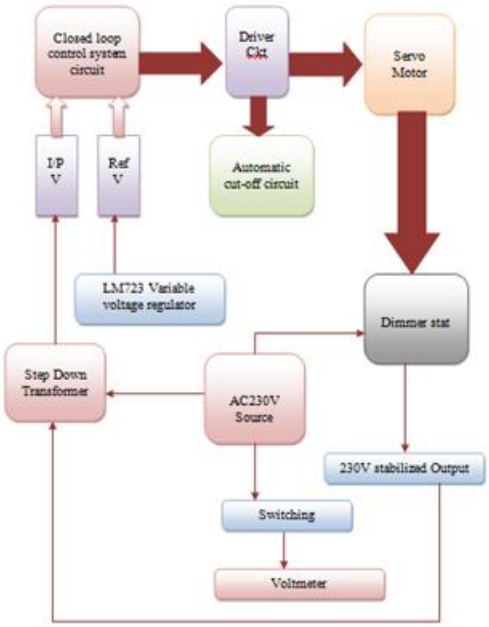

Fig. 1 Block diagram of the system

Servo stabilizer has three major components

- Microcontroller for voltage monitoring
- Driver Unit
- Motorized variable voltage auto transformer
- Double-wound Buck Boost / Series transformer
- Servo controlled sensing card (PCB)

After determining Input voltage band and load of customer we design our servo stabilizer to take care of the minimum and maximum voltage fluctuations. While ordering servo stabilizer care should be taken to ensure that servo stabilizer capacity is 20% more than maximum load. In servo stabilizer determine output is determined voltage and the same is set by means of servo controlled sensing card (PCB). Whenever change in output voltage which occurs due to change in Input voltage, the servo controlled sensing card (PCB) gives signal to the motor fitted on variable voltage auto transformer to either increase or decrease the output voltage to achieve the predetermined output voltage.

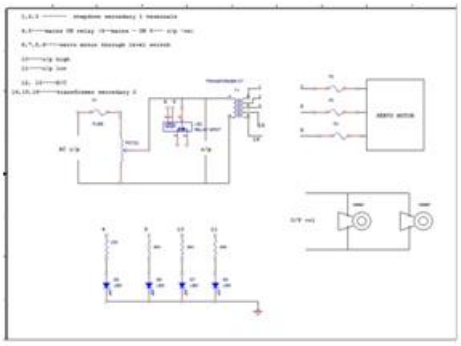

Fig. 2 circuit diagram

IV. COMPONENT DETAILS:

4.1 AUTOTRANSFORMER

An autotransformer has only a single winding, which is tapped at some point along the winding. AC or pulsed voltage is applied across a portion of the winding, and a higher (or lower) voltage is produced across another portion of the same winding. While theoretically separate parts of the winding can be used for input and output, in practice the higher voltage will be connected to the ends of the winding, and the lower voltage from one end to a tap. For example, a transformer with a tap at the center of the winding can be used with 230 volts across the entire winding, and 115 volts between one end and the tap. It can be connected to a 230 volt supply to drive 115 volt equipment, or reversed to drive 230 volt equipment from 115 volts. As the same winding is used for input and output, the flux in the core is partially cancelled, and a smaller core can be used. For voltage ratios not exceeding about 3:1, an autotransformer is cheaper, lighter, smaller and more efficient than a true (two-winding) transformer of the same rating.

4.2 LM723

The LM723/LM723C is a voltage regulator designed primarily for series regulator applications. By itself, it will supply output currents up to 150 mA; but external transistors can be added to provide any desired load current. The LM723/LM723C is also useful in a wide range of other applications such as a shunt regulator, a current regulator or a temperature controller.

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FEATURES

- 150 mA Output Current without External Pass Transistor.
- Output Currents in Excess of 10A Possible by Adding External Transistors.
- Input Voltage 40V Max. Output Voltage Adjustable from 2V to 37V.

4.3 LCD Interface:

The LCD is driven by the PIC via a 4bit interface. Pins RB0-RB3 on the PIC connects to the 4bit mode data pins on the display. The Enable and RS pins on the display are connected to RB4 and RB5 on the PIC.

4.4 IC 7805 &S IC 7812

7805 & 7812 is an integrated three-terminal positive fixed linear voltage regulator. It supports an input voltage of 10 volts to 35 volts and output voltage of 5 volts. It has a current rating of 1 amp although lower current models are available. Its output voltage is fixed at 5.0V. The 7805 also has a built-in current limiter as a safety feature. 7805 is manufactured by many companies, including National Semiconductors and Fairchild Semiconductors.

4.5 RELAY

A relay is an electrical switch that opens and closes under control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered, in a broad sense, to be a form of electrical amplifier.

V. APPLICATIONS:

The IEC is an indispensible companion with all the high tech electrical & electronic equipment & machinery required steady voltage input. It will find fruitful applications in. Like Computer Centers, Hospitals, Offices , Factories , Scientific Laboratories , Flour Mills , Paper Mills ,Pharmaceutical Units etc.

VI. CONCLUSION:

Hence by this project we can constantly monitors the output voltage and controls the variations in the input voltage by movements of a motor.

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